



# Equipment Upgrades and Preventive Maintenance Improve Performance and Reduce SF<sub>6</sub> Emissions



The SF<sub>6</sub> Emission Reduction Partnership for Electric Power Systems is a voluntary program between the Environmental Protection Agency (EPA) and electric power companies. Its goal is to identify and implement cost-effective operational and technical solutions to reduce SF<sub>6</sub> emissions. By reducing SF<sub>6</sub> emissions where feasible, the electric power industry can play a key role in addressing climate change. This Partnership is one of several EPA voluntary programs working with specific industries that emit potent greenhouse gases.

## ITCTransmission Case Study

ITCTransmission is the nation's first fully independent electricity transmission company. With a service territory of approximately 7,600 square miles, the company delivers electricity to nearly 4.9 million people in southeastern Michigan. The company is focusing on enhancing operation, maintenance, and investment in its transmission infrastructure. As an important step toward improved operation, ITCTransmission recently implemented several initiatives that reduced sulfur hexafluoride (SF<sub>6</sub>) emissions by 79 percent within a two-year period, and in the process, also reduced annual expenditures to replace and manage SF<sub>6</sub> gas losses.

### Company Profile

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In April 2004, ITCTransmission became the first, fully independent electricity transmission company in the United States, following the transfer of ownership from DTE Energy to its parent company, ITC Holdings Corp. ITCTransmission owns a fully regulated, high-voltage system that transmits electricity to local electricity distribution facilities. The company currently serves a population of approximately 4.9 million throughout 13 southeastern Michigan counties, including the Detroit metropolitan area. With the combined service areas of ITCTransmission and Michigan Electric Transmission Company, LLC (METC), ITC Holdings Corp. is operating the largest transmission system in Michigan's Lower Peninsula. Additionally, on December 20, 2007, ITC Midwest LLC, a subsidiary of ITC, completed the acquisition of the transmission assets of Interstate Power and Light Company (IPL), a subsidiary of Alliant Energy Corporation. The transaction included the purchase of 6,800 miles of IPL transmission lines at voltages of 34.5 kilovolts and above, and 170 stations and substations in portions of Iowa, Minnesota, Illinois, and Missouri.

Seeking to improve its operations, ITCTransmission is exploring opportunities to enhance the transmission system's integrity and reliability. In 2007 the company joined the U.S. Environmental Protection Agency's (EPA) SF<sub>6</sub> Emission Reduction Partnership for Electric Power Systems. The Partnership is a voluntary program between government and electric utilities with a focus on developing and implementing cost-effective operational and technical solutions to reduce SF<sub>6</sub> emissions and improve SF<sub>6</sub> handling and maintenance.

## Benefits of Joining the Partnership

ITC*Transmission* joined the SF<sub>6</sub> Emission Reduction Partnership for four reasons:

- To institute an industry standard for reporting of emissions and inventory tracking, resulting in reduced SF<sub>6</sub> gas purchases and related cost savings;
- To implement best practices in SF<sub>6</sub> gas handling, resulting in emissions reductions on the transmission system;
- To collaborate with other utility Partners and EPA in developing and improving industry best practices in SF<sub>6</sub> gas handling and maintenance; and
- To be recognized nationally for efforts and successes in reducing greenhouse gas emissions.

## Initiatives to Reduce SF<sub>6</sub> Emissions

ITC*Transmission* is reducing its SF<sub>6</sub> gas emissions through two key programs: (1) an infrastructure improvement program, which addresses equipment replacement, and (2) a preventive maintenance program, which targets equipment repair. ITC*Transmission* has made a strong commitment to reduce emissions by accelerating the repair and, when appropriate, early retirement of leaky equipment. Tracking the costs associated with repair operations including replacement gas and labor, as well as the costs associated with installing new equipment, facilitates decision-making.<sup>1</sup>

### 1. Infrastructure Improvement Program

The utility's infrastructure improvement program consists of two equipment replacement projects, targeting circuit breakers and gas insulated switchgear (GIS).

<sup>1</sup> With the recent acquisition of METC by ITC Holdings Corp., the SF<sub>6</sub> emission reduction initiatives implemented by ITC*Transmission* are beginning to be implemented by METC.

<sup>2</sup> Typical circuit breakers to be replaced include: Westinghouse 145SF / 3450-SF; General Electric ATB-362-7Y, 7, and 5; and ITE 230-GA20-20B / 242GA-40-20C / 145GA-30-20C / 145GA-63-20C / Delle Alstom FB-2A.

<sup>3</sup> Regarding outdoor circuit breakers, there is an agreement between the supplier and the utility that the breaker will maintain a maximum permissible leak rate of 1 percent per year, otherwise the breaker will be repaired for free by the supplier.

### Circuit Breaker Replacement Project

ITC*Transmission* has an ongoing circuit breaker replacement project that began in 2003. Under this project, the utility tracks the frequency of maintenance of its gas breakers to help prioritize which ones should be replaced. In making the decision to replace equipment, maintenance costs and performance records of leaking breakers are reviewed and compared to the costs to replace the breakers. The utility also considers other benefits associated with new breakers, such as greater equipment reliability. To date, the company has selected variations of SFMT models supplied by Mitsubishi Electric as its equipment replacements, chosen in part due to their quality of design and leak-tight construction.<sup>2</sup> The Mitsubishi SFMT models have low gas leak rates, from 0.1 percent to 1 percent per year.<sup>3</sup>

Since beginning the circuit breaker replacement project, ITC*Transmission* has replaced or decommissioned 57 leaking circuit breakers, varying in size and designed for 120 kV to 345 kV transmission systems with a vintage range from 1964 to 1982. With the new circuit breakers installed, the manufacturer conducts periodic checks to verify that gas system pressure, quality, and moisture are normal. In the event of a low-pressure alarm signal, the manufacturer investigates any evidence of leaks under warranty. As a result of these replacement efforts, ITC*Transmission* reduced its SF<sub>6</sub> gas emissions and continues to operate the successful replacement program. To date, no detectable SF<sub>6</sub> leaks from newly replaced equipment have occurred.

## Circuit Breaker Replacement Project



*Before:* Leaking GE ATB-7 Circuit Breaker that uses a separate gas insulated current transformer (CT).



*After:* Replacement 300-SFMT-63E Gas Circuit Breaker with fewer fittings and a simpler design. The newer style gas breakers utilize slip-over CTs on the outside of the bushings that do not require gas insulation.

## GIS Infrastructure Replacement Project



*Before:* Leaking GIS at the St. Antoine Substation.



*After:* ITC Holdings Corp. replaced the leaking GIS at the St. Antoine Substation with new equipment supplied by Mitsubishi Electric.

## GIS Infrastructure Replacement Project

The second major project in the Infrastructure Improvement Program focuses on replacement of GIS. The utility's transmission system acquired four in-service GIS sites manufactured between 1970 and 1972: St. Antoine (ITE), Caniff (Delle Alsthom-Cogenel), Midtown (Delle Alsthom-Cogenel), and Cato (Delle Alsthom-Cogenel). Following the transfer of ownership and commencement of independent operation in 2004, ITCTransmission determined that these substations were a significant source of SF<sub>6</sub> emissions. The leaks and intensive maintenance required for each site prompted the decision to replace the aging GIS with newer equipment.

In 2005, the utility initiated a plan to replace these installations over a period of four to six years. The maintenance-prone, dual-pressure gas circuit breakers at the St. Antoine facility were of particular concern, and, therefore, this site was targeted first.

By the second quarter of 2007, equipment in the St. Antoine and Caniff substations had been replaced with new equipment supplied by Mitsubishi Electric that has a combined SF<sub>6</sub> nameplate capacity of 8,050 pounds.<sup>4</sup> Workers recovered the gas remaining in the replaced GIS, verified that the gas met acceptable criteria for reuse, and then returned the recovered gas to ITCTransmission's inventory for future use.

<sup>4</sup> The written commercial contract stipulates the replacement GIS has a leak rate of less than 0.1 percent per year and if it fails to meet these specifications it must be repaired for free by the supplier.

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A total of 25 bottles or 2,875 pounds of SF<sub>6</sub> gas was recovered and added to inventory. The Midtown and Cato substations, with a combined SF<sub>6</sub> nameplate capacity of 5,000 pounds, have replacement pending.

The GIS replacement project at the St. Antoine (ITE) site alone enabled the company to eliminate approximately 104 man-hours of labor in the winter and 24 man-hours in the summer. Additionally, the company has eliminated the need to purchase approximately 16 cylinders of SF<sub>6</sub> gas annually (about 1,840 pounds) to replace losses from the leaking equipment.

## 2. Preventive Maintenance Program

ITC*Transmission's* equipment replacement programs are complemented by an aggressive maintenance plan launched in 2004, which includes repairing leaks in equipment not ready for replacement. ITC*Transmission's* workforce has since taken on a number of repairs including installing bolted-on clamp/seal rings around leaking gas breaker bushings, repairing gas breaker tube fittings, replacing seals at interrupter flanges, and replacing leaking underground pothead flange valves. Generally these repairs are being made on equipment manufactured between the 1970s and 1990s.

## Company Achievements

Through the initiatives described above, ITC*Transmission* is implementing industrial best practices and maintenance techniques in handling SF<sub>6</sub> gas into its standard operating procedures—achieving significant emissions reductions and operational efficiencies.

- In 2005, the first full year for which the utility tracked its SF<sub>6</sub> gas emissions, ITC*Transmission* calculated a total annual emissions estimate of 13,725 pounds, using EPA's recommended mass-balance method. In 2006, the utility calculated 6,546 pounds of annual emissions—

## Leak Detection Practices

Leaks are first identified using the low-gas density alarm included with the circuit breaker. A work request is subsequently issued to personnel to locate the leak source and repair it, thus avoiding future refill visits and the associated costs. ITC*Transmission* field personnel locate the leaks using commercially available and inexpensive electronic leak detectors (CPS brand refrigerant leak detector, Model LS790B) and a solution (Snoop liquid leak detector) that forms bubbles upon pinpointing a leak source. This solution is especially suited for cold weather, when many leaks increase due to cold-induced contraction. ITC*Transmission* pays particular attention to the potential for gas leaks from the new equipment installed since 2003, for which leaks should be minimal.

**For more information on the SF<sub>6</sub> Partnership go to:**

[www.epa.gov/electricpower-sf6](http://www.epa.gov/electricpower-sf6)

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an impressive emissions reduction of 52 percent. This significant reduction is largely due to the replacement of leaking equipment and the aggressive preventive maintenance program.

- In 2007, ITC*Transmission* further reduced SF<sub>6</sub> emissions to 5,745 pounds, representing a 58 percent reduction from baseline SF<sub>6</sub> emissions.
- With standard reporting and inventory tracking, ITC*Transmission* is now able to identify and forecast SF<sub>6</sub> gas requirements, facilitating cost savings on SF<sub>6</sub> purchases. As a direct result of its efforts, ITC*Transmission* reduced the need to purchase SF<sub>6</sub> from gas suppliers as ITC*Transmission's* reliance on its own inventory increased.